TSYPIN, M.I.

TRANSACTIONS OF THE INSTITUTE OF NUCLEAR PHYSICS (TRUDY INSTITUTA YADERNOY FIZ IKI) of the KAZAKH Academy of Sciences, Volume 2, by Different authors, Kazakh Academy of Science Publishing House ALMA-ATA, USSR, 1959.

A method of preparing electron diffraction study preparation.

ACCESSION NR: AR4018340 S/0137/64/000/001/I099/I099

SOURCE: RZh. Metallurgiya, Abs. 11645

AUTHOR: Layner, D. I.; Tsy*pin, M. I.; Bay, A. S.

TITLE: Electron microscopic study of the scale structure on titanium

CITED SOURCE: Tr. Gos. n.-i. i proyektn. in-ta splavov i obrabotki tsvetn. met., vy*p. 21, 1963, 69-78

TOPIC TAGS: titanium scale, titanium oxidation

TRANSLATION: Cr-shadowed replicas of Ti scale were studied with an EM-3 electron microscope having a resolving power of ~100 Å. When Ti is oxidized in air, the coarse outer crystalline layer does not penetrate into the interior of the scale even under drastic oxidation conditions (900 C, 5 hr). When Ti is oxidized in steam, the columnar layer of scale on Ti, formed by large fused acicular crystals, makes up the bulk of the scale. L. Petrova

SUB CODE: MM ENCL: 00

Card 1/1

45225

18.8300

S/806/62/000/003/010/018

AUTHORS: Layner, D.I., Tsypin, M.I.

TITLE: On the first stages of the oxidation of titanium.

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniye splavov tsvetnykh metallov. no.3. 1962, 116-125.

TEXT: The paper describes an investigation concerned with the initial stages of the oxidation of Ti in air and in water vapor and demonstrates that the oxidizing medium determines not only the kinetics of the oxidation but also characteristics of the scale formed, such as the type of the growth texture. Electron-microscopy was employed largely. A Ti-O phase diagram is plotted from all available literature data, including the boundary of the ordering of the α solid solution, more accurate information on the composition and boundary of the ω phase, the region of existence of α and β TiO, the magnetic transformation in Ti_2O_3 at 160°C, and a presentation of the homologous series of $Ti_nO_{2(n-1)}$ oxides. The tests for thin oxide films consisting of rutile showed that the rutile film is practically one single crystal thick (450-550 Å upon oxidation in air at 550°C) and that it is formed predominantly by outward diffusion of Ti ions. This is in agreement with the conclusions of P. Kofstad et al. (Acta Chem. Scand., no.12, 1958, 239-280) relative to the kinetics of scale

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On the first stages of the oxidation of titanium. S/806/62/000/003/010/018

formation at 300-600°. The Kofstad mechanism is briefly summarized and present electron-microscope evidence is adduced to confirm it. With increasing T and oxidation time the formation of more and more sharply bounded rutile crystals was observed, the exterior shape of which is consistent with textbook examples of the habitus of rutile crystals and twins. Disagreement with Kofstad's interpretation of the experimental facts is based on the following reasonings: Kofstad assumed that the determining element in the scale formation is the diffusion of O ions toward the scale-metal discontinuity surface. He oxidized the Ti after rolling, under the assumption that the rolling texture of the Ti would be reflected in the texture of the scale. The appearance of a texture in the scale was then taken to represent a confirmation of the assumption. If that were so, then the oriented texture would follow the texture of the metal best where the scale layer is extremely thin and – in thick scale – where the scale layer adhered most completely to the metal. Neither of these phenomena was observed by Kofstad; the exact opposite was observed in the present investigation (photographs). That rolling texture cannot have much influence on the texture of the scale is also reasonably concluded from the fact that the oxidation occurs in conditions (850°C) in which the Ti specimen is annealed. It is shown that the scale texture cannot be due to recrystallization of the TiO_2 and that the only admissible mechanism for scale formation is its formation on its exterior surface and consists of a reaction between the Ti ions diffusing outwardly from the interior

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On the first stages of the oxidation of titanium. S/806/62/000/003/010/018

and the ambient O. Other investigations have not been able to identify any orientation of the scale texture at all, and this is attributed to the preliminary grinding and etching of the Ti-specimen surface which resulted in a disordered microrelief comparable in height with that of the rutile crystals (1 μ). The rolling-and-annealing method used to prepare the specimens in the present investigation yielded a microrelief a full order of magnitude lower and two orders of magnitude less dense (in humps per running mm) than the grind-and-etch method and, hence, interfered less with any textural tendency of the scale growth. The second set of experiments, with oxidation accomplished in water vapor, showed not only much greater intensity of oxidation but also a fundamentally different type of oxidation process than in air: With increasing T and time the outer scale surface becomes increasingly smooth, because the crystals formed in steam oxidation grow so large that their flat surface becomes relatively large with respect to their inter-crystal boundaries. Then, once the rutile crystals grow beyond 5 μ, a fundamentally novel stage occurs, with the rapid growth of thin acicular crystals at separate points of the surface (photograph). These needles were found to be near-perfect rutile single-crystals as demonstrated by the existence of Kikuchi lines in the microdiffractional pictures. With increasing T and time the needles grow in length and thickness and occupy an increasing portion of the visual field of the electron microscope. They become firmly attached to the underlying rutile layers, until the replicas show no

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On the first stages of the oxidation of titanium. S/806/62/000/003/010/018

more than imprints of a new scale surface formed by the tops of the mutually adjacent acicular crystals, which meanwhile have grown individually beyond the visual field of the electron microscope ($>10\ \mu$), so that only portions of these crystals with distinctly formed edges are visible. Thus it is confirmed that in oxidation in water vapor, too, the determining element in the formation of Ti scale is the outward diffusion of Ti ions from the interior or parent mass of the metal toward the discontinuity surface. Water-vapor experiments lasting more than an hour at 850°C revealed: (1) An outer grey layer, (2) a discontinuity between the grey layer and a dark layer adhering to it, or (3) a discontinuity between the dark layer and a bright surface with a metallic sheen. All of these surfaces were investigated by the electronographic method (one and one-half pages of tabulated data). The two rutile sublayers can also be clearly identified in polarized light, with the lamellar and the acicular crystals well in evidence. The findings are summarized in a set of 4 cross-sectional sketches illustrating the various scale-formation layers ranging from air at 300°C through water vapor at 850°C. There are 7 figures, 3 tables, and 19 references (8 Russian-language, of which 7 are Soviet and 1 appears to be a translation from the English, and 11 English-language).

ASSOCIATION: None given.

Card 4/4

NOVIKOV, A.V., TSYPIN, M.I.

TRANSACTIONS OF THE INSTITUTE OF NUCLEAR PHYSICS (TRUDY INSTITUTA YADERNOY FIZ IKI) of the KAZAKH Academy of Sciences, Volume 2, by Different authors, Kazakh Academy of Science Publishing House ALMA-ATA, USSR, 1959.

Concerning the electric resistance temperature coefficient of Manganin type alloys.

LAYNER, D.I.; TSYPIN, M.I.

First stages of titanium oxidation. Issl. splav. tsvet. met. no.3:116-125 '62. (MIRA 15:8)
(Titanium--Metallography) (Oxidation)

LAYNER, D.I.; TSYPIN, M.I.

Studying the structure of titanium scale in the process of its formation. Trudy Giprotsvetmetobrabotka no.20:42-64 '61. (MIRA 15:2)

(Titanium--Corrosion) (Electron diffraction examination)

LAYNER, D.I.; TSYPIN, M.I.

Some structural characteristics of scale formation on titanium.
Trudy Giprotsvetmetobrabotka no.20:28-41 '61. (MIRA 15:2)
(Titanium--Corrosion) (Electron microscopy)

S/126/62/013/004/010/022
E111/E435

AUTHORS: Layner, D.I., Tsypin, M.I.

TITLE: Some problems of the formation of scale on metals

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.4, 1962, 561-566

TEXT: On the example of titanium the optimum conditions for revealing texture in oxide layers are determined. Electron-diffraction patterns indicated texture in the surface layers, probably associated with the surface geometry of their initial titanium. The best starting material from surface-preparation aspects for studying scale on sheets is one annealed after cold-rolling in a vacuum. In studying texture in scale, identification of orientation with growth or orientation compatibility texture is important. From the observations made it is evident that the surface of the scale is where the main scale component (rutile) is formed, but the interpretation of similar results by P.Kofstad, K.Hauffe and H.Kjöllesdal was incorrect. Another possible cause of scale texture is recrystallization of titanium dioxide on heating at up to 850°C for three hours, thus leaving

growth texture as the cause (for oxidation in air, steam and oxygen); this has not been confirmed by the present authors. Examination of scale obtained under various conditions suggests that the formation of a new layer of scale depends essentially on surface and not volume diffusion. Published views on these questions are contradictory. The above results relate to relatively thick scale layers. Next, oxide layers, only some hundreds of angstroms thick, are considered. Microdiffraction investigation (with an electron microscope) has shown that within the boundaries of a grain of the original metal the oxide is precisely orientated, but as this orientation varies from grain to grain the macroscopic orientation of the oxide crystals is random: thus, failure to detect texture by ordinary X-ray and electron diffraction studies of thin films does not indicate absence of connection between oxide orientation and base structure. As scale thickens, orientation differences between adjacent colonies of crystals rather than between oxide crystals affect the orientation within the boundaries of a micro-grain of the original metal. In the case of growth of needle-like rutile crystals,

ordinary X-ray and electron diffraction results can be misleading and electron microscopy with micro-diffraction must be used. Scale structure should always be studied by several methods. The authors state that their ideas and results are applicable to metals in general. There are 7 figures.

ASSOCIATION: Institut "Giprotsvetmetobrabotka"

SUBMITTED: September 4, 1961

Card 3/3

LAYNER, D.I.; BAY, A.S.; TSYPIN, M.I.

Kinetics of oxidation and the structure of scale on titanium.
Fiz. met. i metalloved. 16 no.2:225-231 Ag '63. (MIRA 16:8)

1. Gosudarstvennyy nauchno-issledovatel'skiy i proyektnyy institut obrabotki tsvetnykh metallov.
(Titanium--Metallography) (Oxidation)

35041
S/680/61/000/020/004/013
D205/D302

18.1281

AUTHORS: Layner, D. I. and Tsypin, M. I.

TITLE: Some structural features of scale formation on titanium

SOURCE: Moscow. Gosudarstvennyy nauchno-issledovatel'skiy i proyektnyy institut obrabotki tsvetnykh metallov. Sbornik nauchnykh trudov. no. 20, 1961. Metallovedeniye i obrabotka tsvetnakh metallov i splavov, 28-41

TEXT: The structural characteristics of the scale are the basis on which one's notions on the diffusion mechanism in the oxidation process are formed. Parting from this point of view, investigations were carried out by the same authors on the oxidation of titanium (Ref. 1: Sb. nauchnykh trudov instituta "Giprotsvetmetobrabotka", no. 20, Metallurgizdat, 1961, this collection, pp. 42-64). The present article is connected with the methods of determining the scale-formation features. The methods of calculating the interplanar distances of titanium dioxide was based on Ormont's work (Ref. 6: Struktury neorganicheskikh veshchestv (Structures of Inorganic

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Substances), Gostekhteoretizdat, 1950) and of the intensivities on V. K. Vainshteyn's book (Ref. 7: Strukturnaya elektronografiya (Structural Electronography), AS USSR, 1956). The preferential orientation of the rutile lattice during various regimes of oxidation is discussed in relation to the electronographic images. It is argued that structure of the titanium dioxide scale explains the diffusion mechanism. Some of the conclusions pertaining to this article are given in Ref. 1 (Op. cit.) which is the following paper in this collection. There are 16 figures, 3 tables and 10 references: 7 Soviet-bloc and 3 non-Soviet-bloc.

35042
S/680/61/000/020/005/013
D205/D302

18.1285

AUTHORS: Layner, D. I. and Tsypin, M. I.

TITLE: Investigating the structure of titanium scale during its formation

SOURCE: Moscow. Gosudarstvenny nauchno-issledovatel'skiy i proyektnyy institut obrabotki tsvetnykh metallov. Sbornik nauchnykh trudov. no. 20, 1961. Metallovedeniye i obrabotka tsvetnykh metallov i splavov, 42-64

TEXT: The oxidation of titanium is of practical and theoretical interest. On the practical side, it is connected with the problem of corrosion resistance and with some technological properties, for example antifrictional, of oxide layers. On the theoretical side, many problems still remain unsolved. One of these is the relative roles of the titanium and oxygen ions in the diffusional process, the other is the cubic relationship of the rate of oxidation between 300 and 600°C. The oxidized films were separated from the metal by the use of the etching mixture: 35 ml HCl, 0.1 - 1.0

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Investigating the structure ...

g NaF, 65 ml H_2O. After separation, the floating oxide films were removed with a glass spatula, washed twice in distilled water, dried and placed in the electronograph. Good electronograms were obtained which showed that only one phase, that of TiO_2, was present. Thickness of the film was determined from the electronograms and plotted vs. time of oxidation for various oxidation temperatures in the 350 - 750°C range. Films obtained at higher temperatures were examined by X-rays and microscopically, owing to their thickness which made them unsuitable for electronographic investigation. In addition, samples of sheet titanium were oxidized in steam at 450, 650 and 850°C. The oxidation of Ti in the 300 - 600°C range followed the cubic relationship and generally confirmed the mechanism proposed by Cofstad et al. (Ref. 1: Acta Chem. Scand. 12, 239, 1958), based on the diffusion of oxygen into the metal from the oxide. Above 600°C a prevailing orientation begins to appear on the external surface of the oxide, pointing to this surface as the locus of the oxide layer formation. Simultaneously the parabolic oxidation becomes prevalent and the diffusion of Ti ions through

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the film becomes the determining factor. This process begins after the scale thickness has reached the value of 5000 Å. The prevalent orientation of the oxide consists in the /301/ planes of rutile being parallel to the specimen plane. The configuration of ions in these planes permitted the accommodation of paired oxygen ions which greatly facilitated the chemisorption of O_2 molecules.

During oxidation by water vapor the general picture remained unchanged, but the atomic state of the present oxygen induced a different texture of the titanium oxide layer, in which the /001/ planes of the rutile lattice were parallel to the plane of the specimen. Lowering the free energy changes in this reaction gave rise to the formation of lower oxides in the deeper layers of the scale, closer to the metallic phase. There are 19 figures, 7 tables and 9 references: 2 Soviet-bloc and 7 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: P. Cofstad, K. Hauffe and H. Kjollestal, Acta Chem. Scand. 12, 239, (1958); A. E. Jenkins, J. Inst. Met. 82, 213, (1953-54); M. H. Davis and C. E. Birchenall, J. of Metals, 3, 877, (1951); T. Hurlen, Acta Chem. Scand., 13, 365, (1959).

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TSYPIN, M. I.

Cand Tech Sci - (diss) "Structure of skin on titanium." Moscow, 1961. 17 pp; (Ministry of Higher and Secondary Specialist Education RSFSR, Krasnoyarsk Inst of Non-Ferrous Metals imeni M. I. Kalinin); 200 copies; price not given; (KL, 7-61 sup, 248)

LAYNER, D.I. (Moskva); TSYPIN, M.I. (Moskva)

Titanium oxidation in the 300-600° temperature range. Izv. AN SSSR. Otd. tekh. nauk. Met. i topl. no.1:146-147 Ja-F '61. (MIRA 14:2)
(Titanium--Corrosion) (Metals, Effect of temperature on)

TRANSLATION

S/180/61/000/001/014/015
E073/E535

AUTHORS: Layner, D. I. and Tsypin, M. I. (Moscow)

TITLE: On the Oxidation of Titanium in the Temperature Range 300 to 600°C

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1961, No.1, pp.146-147

TEXT: Usually the "weight increment-time" relations of oxided metallic specimens as a function of temperature are straight lines, parabolas or logarithmic curves. Existing oxidation theories by Wagner, Dankov, Mott and others propose oxidation mechanisms that lead to these relations. However, P. Cofstad, K. Hauffe and H. Kjöllesdal (Ref.1) have established that in oxidation of titanium in the temperature range 300 to 600°C the dependence of the weight increase on time is represented by a cubic parabola, a feature which has not been observed in the oxidation of other metals. Titanium can absorb up to 30 at.% of oxygen which dissolves in the metal and Cofstad et al. proposed a mechanism of oxidation which explains the experimentally determined time dependence of the weight increase by diffusion of oxygen in metallic titanium through

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On the Oxidation of Titanium ....

an oxide film of constant thickness. Detection of the existence of such films would be a decisive factor in judging whether this mechanism does really take place. For this purpose the authors used a very simple and sufficiently accurate method of determining the thickness of oxide films from their interference colours. Spectrum analysis of arc smelted titanium sheet specimens showed the presence of about 0.04% Si and other metallic admixtures in quantities below 0.01% each (a total of 12 elements were determined). After vacuum annealing (10^{-4} mm Hg) for 30 mins at 800°C the specimens were cleaned with alcohol and oxided in air. The correspondence of the well known coloration of oxide films on the titanium for the temperature range 350 to 700°C with interference phenomena is confirmed by the table, which indicates the sequence of alternating the colours of the Newton ring and the colours of the wedge-shaped layer of oxides at the surface of the titanium strip, one end of which was in air, whilst the second end was in a furnace at 800°C. The film thickness δ is determined by means of the expression

$$\delta = k \frac{\lambda}{4n}$$

where k = 1,2,3... is the order of reflection, λ is the wavelength of the particular colour which is complementary to the colour of the film, n - refractory index of the film. In this equation the error in the visual determination of λ is about 1.5 to 2% (10 to 15 μ at wavelengths of 400 to 700 μ). The main error is introduced in the averaging of the refraction coefficient for optically uniaxial crystals of TiO_2-rutile, of which the oxide layers are formed (see earlier work of the authors, Refs.3 and 4), as well as by not taking into consideration dispersion. The average value $n_{av} = 2.8$ if the maximum scatter is 2.6 to 3. Thus, the total random error in the thickness of the film can be evaluated at 10%. Furthermore, a systematic error is introduced due to the absence of accurate data on the conditions of reflections at the boundary oxide-metal; however, this effect is of importance only for the absolute film thicknesses but does not manifest itself on the characteristic form of the curves "film thickness-time". The calculated values of the film thickness were qualitatively confirmed by the change in the character detected in recent electron diffraction investigations of the authors (Ref.4).

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The obtained film thickness values given in the graphs (top graph a - for the temperature range 350 to 600°C; bottom graph b - for the range 550 to 700°C; δ, Å vs. τ,min) show clearly that if titanium is oxided in the temperature range 350 to 550°C the forming oxide films will reach a practically constant thickness and, consequently, the results confirm the correctness of the mechanism for oxidation of titanium in the intermediate temperature range (about 300 to 600°C) proposed by Cofstad et al. There are 1 figure, 1 table and 4 references: 3 Soviet (1 a translation from English) and 1 non-Soviet.

(Note: this is a complete translation)

SUBMITTED: January 28, 1960

On the Oxidation of Titanium S/180/61/000/001/014/015
E073/E535

Sequence of Basic Colours of the Wedge-shaped Oxide Layer on Titanium

Order of reflection	Colour of the wedge-shaped air gap (Newton ring) in transmitted light	Colour of oxides on titanium in reflected light
I	Yellow	Yellow
	Red to	Brown
	Violet	
	Dark Blue	Violet
		Dark Blue
	Green	Pale Blue
		Greenish
II	Yellow	Yellow
	Red	Purple
		Violet
	Dark Blue	Dark Blue
	Green	Green

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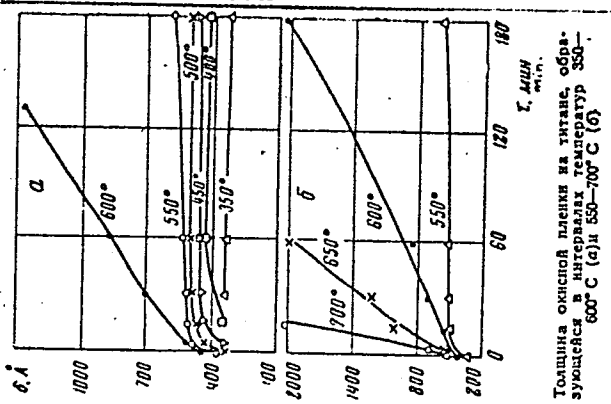
III	Yellow Red Greyish Blue Green	Yellow Purple Dark Blue Green
IV	Dull-yellow Red Green	Greyish-yellow Dull-violet



Толщина окисной пленки на титане, образующейся в интервалах температур 350—600° С (а) и 550—700° С (б)

Fig.

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LAYNER, D.I.; TSYPIN, M.I.

Structure of scale on titanium. Fiz. met. i metalloved. 10 no.4:544-554 O '60. (MIRA 13:11)

1. Giprotsvetmetobrabotka, Moskva.
(Titanium--Metallography) (Metallic films)

85039

18.8300 1530, 1520, 1138 only

S/126/60/010/004/007/023
E021/E435

AUTHORS: Layner, D.I. and Tsypin, M.I.

TITLE: The Structure of Scale on Titanium

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.4, pp.543-554

TEXT: Previous work had been carried out on relatively impure titanium. The present work used titanium containing only 0.045% Si and less than 0.01% remaining impurities. No diffraction pattern could be detected by electronic diffraction examination of the surface of the specimens immediately after heating in vacuo, which proves that an irregular structure is present on the surface. Titanium hydride formed on the surface after etching in acid media and it was not possible to obtain a sharp diffraction picture of metallic titanium even after polishing on abrasive papers. The titanium sheet immediately after vacuum heating was therefore taken as the starting material. Oxidation was carried out in a muffle furnace and the samples were cooled in air. The main methods of examining the structure of the scale produced were: electron diffraction and X-ray analysis. The former shows the structure of a film 10^{-6} cm thickness and the latter 10^{-3} cm. Oxidation at

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85039

S/126/60/010/004/007/023
E021/E435

The Structure of Scale on Titanium

350 to 550°C produced thin films of oxide, reaching a constant thickness for a given temperature. The film was shown to be almost completely rutile. At higher temperature thicker films were produced which were also examined by metallographic techniques. At 700 to 850°C (up to three hours) two films were formed. The outer film was white and relatively thick and consisted of rutile with not less than 1.97 oxygen atoms to each titanium atom. The inner film was darker and much thinner. It was also shown to be based on rutile with a lower oxygen content (probably not less than 1.90). With increased temperature and time of oxidation, the outer film showed a sharply expressed orientation with the (301) planes parallel to the surface. Microhardness measurements showed that the inner film was harder than the white outer film. Oxidation at high temperature (850°C) by water vapour produced a film of rutile with the (001) planes parallel to the surface. It is proposed that oxidation by air takes place by direct chemisorption of molecules of oxygen and they take their place in the rutile lattice without preliminary dissociation into atoms. In the oxidation by water vapour, the orientation of the oxide

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85039

S/126/60/010/004/007/023
E021/E435

The Structure of Scale on Titanium

is determined by the tendency for the densely packed titanium ions to be placed parallel to their original surface of the metal, and the adsorption effect plays little part. The positions of the ions are shown in Fig.13 (for the (301) plane) and Fig.14 (for the (001) plane), the large circles being the oxygen ions and the small circles titanium ions. There are 14 figures, 2 tables and 13 references: 6 Soviet and 7 English.

ASSOCIATION: Giprotsvetmetobrabotka g. Moskva
(Giprotsvetmetobrabotka, Moscow)

SUBMITTED: February 6, 1960

Card 3/3

NOVIKOV, A.V.; TSYPIN, M.I.

Temperature coefficient of electrical resistance of alloys of the manganin type. Trudy Inst. iad. fiz. AN Kazakh. SSR 2:119-123 '59. (MIRA 13:3)

(Copper-manganeze-nickel alloys--Electric properties)

NOVIKOV, A.V.; TSYPIN, M.I.; FRIDMAN, L.P.

Liquation phenomena in ingots of OTsS 4-4-2,5 bronze. Trudy Inst. iad. fiz. AN Kazakh. SSR 2:151-152 '59. (MIRA 13:3)
(Bronze)

LAYNER, D.I.; TSYPIN, M.I.

Methods of studying the structure of oxides formed in titanium. Zav.lab. 25 no.10:1209 '59. (MIRA 13:1)

1. Institut "Giprotsvetmetobrabotka".
(Titanium) (Metallic oxides)

TSYPIN, M.I.

One method making electron diffraction preparations. Trudy Inst. iad. fiz. AN Kazakh. SSR 2:124-128 '59. (MIRA 13:3)
(Electron diffraction examination)

67805

5.2100(4) SOV/180-59-5-22/37

AUTHORS: Layner, D.I., and Tsypin, M.I. (Moscow)

TITLE: Structure of the Scale in the First Stages of the Oxidation of Titanium

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1959, Nr 5, pp 131-132 (USSR)

ABSTRACT: The authors state that in spite of the theoretical and practical importance of the oxidation of titanium, published work is limited to studies in pure oxygen (Refs 1, 2) or at very low pressures (Ref 3), or to impure titanium in air mainly for relatively long periods. Since the early stages, in which some of the numerous lower oxides are likely to participate, are specially interesting, the present authors studied the film produced on technical titanium sheet oxidized in a furnace at various temperatures. The films obtained below 800 °C were studied by electron diffraction; higher-temperature films by reflection. It was found (Table) that at 350-450 °C the main component is rutile and there is a previously observed (Ref 3) additional lime in the diffraction pattern characteristic for early stages of oxidation; at 500-650 °C a mixture of rutile

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Structure of the Scale in the First Stages of the Oxidation of Titanium

with a little Ti_3O_5 is formed; at 700-750 °C the pattern is almost exclusively that of rutile; the outer surface of layers obtained at 800-900 °C consists of strongly textured rutile, the inner surface separating easily from the metal on oxidation for 3 hours gives the normal pattern of polycrystalline rutile; films obtained at 350-750 °C have a preferred orientation (the Figure shows electron diffraction patterns for perpendicular and sloping incidence of the primary beam).

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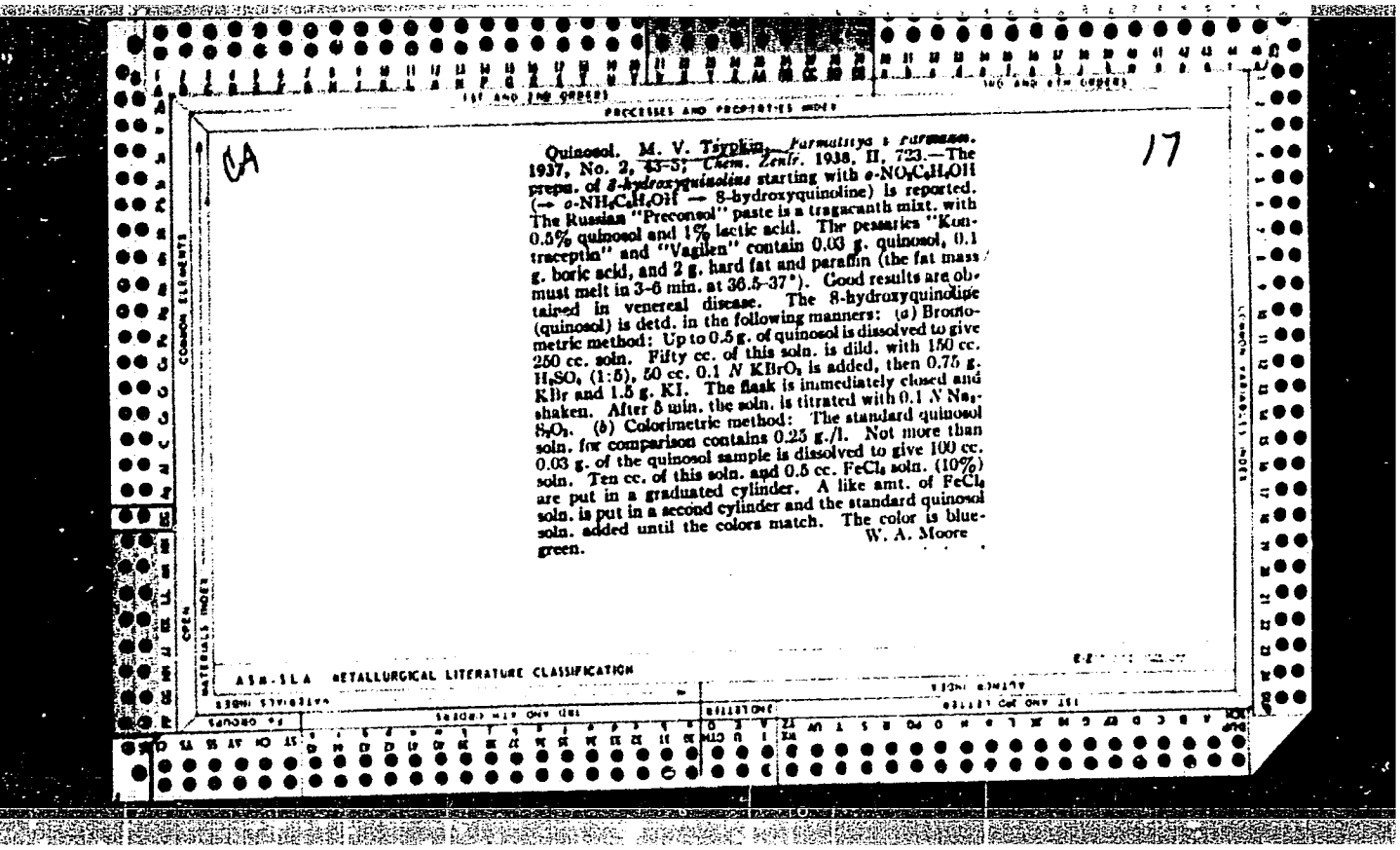
There are 1 figure, 1 table and 7 references, of which 1 is Soviet, 1 is French, 3 are English and 2 are Scandinavian.

4

TSYPIN, M.I., inzhener.

Use of structural electronographic analysis in metallography. Metalloved. i obr. met. no.5:62-64 My '57. (MLRA 10:6)

1. Balkhashskiy zavod po obrabotke tsentnykh metallov.
(Metallography) (Electron diffraction examination)



CA 17

Quinosol. M. V. Tsyplin. *Farmatsiya i Farmakol.* 1937, No. 2, 43-5; *Chem. Zentr.* 1938, II, 723.—The prepn. of *8-hydroxyquinolins* starting with *o*-$NO_2C_6H_4OH$ ($\rightarrow$ *o*-$NH_2C_6H_4OH$ $\rightarrow$ 8-hydroxyquinoline) is reported. The Russian "Preconsol" paste is a tragacanth mixt. with 0.5% quinosol and 1% lactic acid. The pessaries "Kontraceptin" and "Vagilen" contain 0.03 g. quinosol, 0.1 g. boric acid, and 2 g. hard fat and paraffin (the fat mass must melt in 3-6 min. at 36.5-37°). Good results are obtained in venereal disease. The 8-hydroxyquinoline (quinosol) is detd. in the following manners: (a) Bromometric method: Up to 0.5 g. of quinosol is dissolved to give 250 cc. soln. Fifty cc. of this soln. is dild. with 150 cc. H_2SO_4 (1:5), 50 cc. 0.1 *N* $KBrO_3$ is added, then 0.75 g. KBr and 1.5 g. KI. The flask is immediately closed and shaken. After 5 min. the soln. is titrated with 0.1 *N* $Na_2S_2O_3$. (b) Colorimetric method: The standard quinosol soln. for comparison contains 0.25 g./l. Not more than 0.03 g. of the quinosol sample is dissolved to give 100 cc. soln. Ten cc. of this soln. and 0.5 cc. $FeCl_3$ soln. (10%) are put in a graduated cylinder. A like amt. of $FeCl_3$ soln. is put in a second cylinder and the standard quinosol soln. added until the colors match. The color is blue-green.

W. A. Moore

Tsypin, M.I.

2(0) PHASE I BOOK EXPLOITATION SOV/2838

Akademiya nauk Kazakhskoy SSR. Institut yadernoy fiziki

Trudy/Laboratoriya metallovedeniya i fiziki metallov/, tom 2 (Transactions of the Institute of Nuclear Physics, Kazakh S.S.R. Academy of Sciences /Laboratory for Metallurgical Science and Physics of Metals/, Vol 2) Alma-Ata, Izd-vo AN Kazakhskoy SSR, 1959. 169 p. 1,000 copies printed.

Ed.: F. Ya. Osadchiy; Tech. Ed.: P.F. Alferova; Editorial Board: I.G. Grinman, L.I. Dautova, I.G. Dem'yanikov, D.K. Kaipov (Resp. Ed.), S.K. Kalinin, A.A. Presnyakov, and Zh. S. Takibayev.

PURPOSE: This is a collection of articles intended for research scientists, factory laboratory personnel, engineers, technicians, and also students and Aspirants in metallurgy and physics of metals.

COVERAGE: The collection contains research reports which investigate the dependency of alloy properties on their chemical and phase states in a wide range of temperatures down to melting point and set forth much factual material on aluminum, copper, nickel, and other alloys. Theoretical ideas on plasticity and superplasticity, which are described as new, and hypotheses on reasons for the lowered plasticity of solid solutions are propounded on the basis of experimental data. No personalities are mentioned. References are given at the end of each article.

11

05732
SOV/32-25-10-21/63

18(7)
AUTHORS: Layner, D. I., Tsypin, M. I.

TITLE: Methods of Investigating the Structure of Oxides Forming on Titanium

PERIODICAL: Zavodskaya laboratoriya, 1959, Vol 25, Nr 10, p 1209 (USSR)

ABSTRACT: Two mordants dissolving titanium but not titanium oxides were used for detaching thin titanium oxide layers for electronographic investigations. The mordants have the following composition: (1) 350 ml of HCl (conc.), 1 - 10 g of NaF, 650 ml of water, and (2) 10 ml of HF (conc.), 30 ml of HNO_3 (conc.), 30 g of $Pb(NO_3)_2$, 950 ml water. As the structure of the oxide film corroded was equal for both mordants, only the first reagent was used. Titanium samples (1 × 10 × 25 mm) were oxidized for 10 minutes at different temperatures, and the resulting oxide film was corroded for 24 hours. The electronograms obtained (Fig 1) showed that on oxidation at 550° TiO_2 (rutile) is formed; oxide films giving an incomplete diffraction picture are obtained at 350°, while thick oxide films are formed at 750°, the

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Methods of Investigating the Structure of Oxides Forming on Titanium

05732
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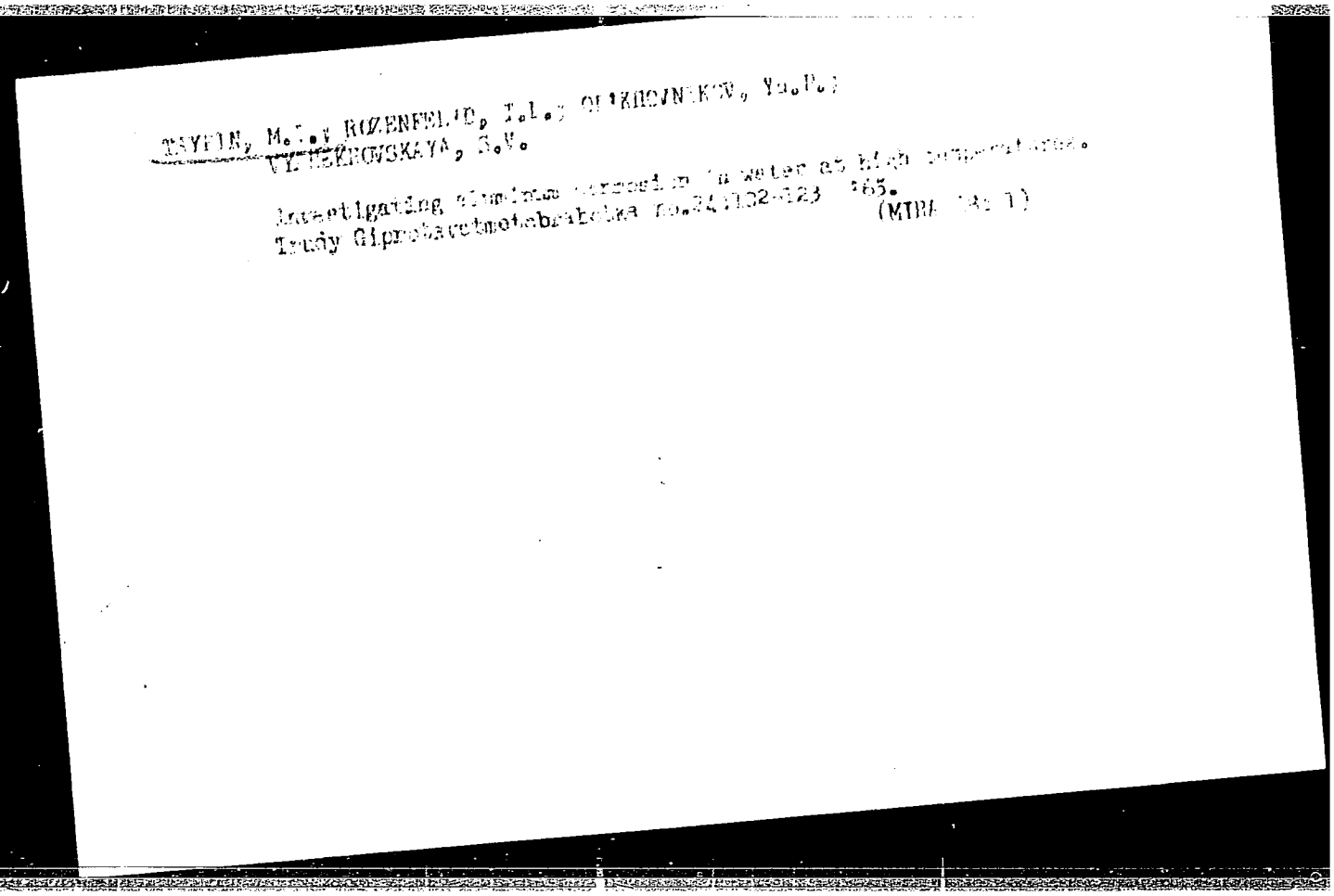
electronograms of which have an intense background. The oxide films detached can be used as replicas for electron-microscopic investigations (Fig 2). There are 2 figures and 1 reference.

ASSOCIATION: Institut "Giprotsvetmetobrabotka" ("Giprotsvetmetobrabotka" Institute)

Card 2/2

LAYNER, D.I.; TSYPIN, M.I.; SLESAREVA, Ye.N.; BAY, A.S.

Mechanism of the electric conductivity of rutile (TiO_2) and the applicability of the Vagner-Khauffe theory to the oxidation processes of titanium and its alloys. Trudy Giprotsvetmetobrabotka no.24:86-92 '65. (MIRA 18:11)



L 15180-66 EWP(e)/EWT(m)/EWA(d)/T/EWP(t)/EWP(k)/EWP(z)/EWP(b) IJP(c) MJW/JD/JW/WB

ACC NR: AP6002666 SOURCE CODE: UR/0126/65/020/006/0864/0867

AUTHOR: Layner, D. I.; Bay, A. S.; Slesareva, Ye. N.; Tsypin, M. I.

ORG: Giprotsvetmetobrabotka

TITLE: Certain features of the process of the oxidation of titanium

SOURCE: Fizika metallov i metallovedeniye, v. 20, no. 6, 1965, 864-867

TOPIC TAGS: titanium, metal oxidation, metal scaling, activation energy, cation / VT1-1 titanium

ABSTRACT: Some quantitative features of the process of the oxidation of VT1-1 titanium at temperatures above 800°C in an air and water-vapor atmosphere at atmospheric pressure are presented. The published literature specifies the rate constants and activation energy for these regimes only for the case of the oxidation of Ti in O_2 and moreover it has been shown that during the oxidation in air of powdered-metal specimens containing 96% Ti the activation energy at temperatures above 800°C differs from the activation energy of oxidation in O_2. As for the process of the oxidation of Ti in water vapors at atmospheric pressure, even less is known about it. Accordingly, the authors performed a metallographic study of the oxidation of Ti in air with the object of determining the activation energies of the total absorption of oxygen, scaling, and absorption of oxygen by the metal base, as a function of the temperature

UDC: 539.21

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ACC NR: AP6002666

D; K_p, cm^2/sec
K_l, cm/sec

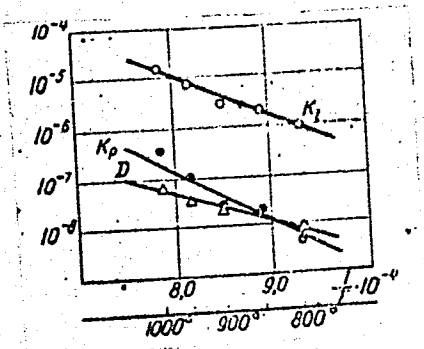

Fig. 1. Temperature dependence of prabolic rate constant K_p and linear rate constant K_e of scale growth, as well as of the coefficient D of the diffusion of Ti ions in scale, for oxidation of Ti in water vapors

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L 15180-66
ACC NR: AP6002666

dependence of the parabolic rate constants of scale growth which showed that the activation energies Q_1 and Q_2 are virtually identical (about 67 kcal/mole-deg) whereas the activation energy Q_3 of the rate constant of oxygen absorption by the metal base is ~74 kcal/mole-deg. The concomitant study of the oxidation of Ti in water vapors showed that in this case the diffusion of ions of the metal through the scale plays a major role and may be described by the relation $K_p/D = 2$, where K_p is the parabolic scale-growth rate constant and D is the diffusion coefficient of metal ions. The activation energies calculated on this basis are 46, 40 and 30 kcal/mole-deg, respectively (Fig. 1) Comparison of K_p and D in the case of oxidation in water vapors at 800-1000°C shows that cation diffusion plays a principal role in the formation of scale under these conditions. Orig. art. has: 1 formula, 1 table, 5 figures.

SUB CODE: 07, 11, 20/ SUBM DATE: 16Jul65/ ORIG REF: 007/ OTH REF: 004

Card 3/3 vmb

TSYPIN, M.Ya., kand.med.nauk

Fixing the dimensions of the "breathing spot" in studying nasal respiration. Vest.oto.-rin. 20 no.3:104 My-Je '58 (MIRA 11:6)

1. Iz otdeleniya bolezney ukha, gorla i nosa 2-y gorodskoy bol'nitsy, g. Bel'tsy.
(RESPIRATION)

TSYPIN, M.Ya., kand.med.nauk

Method for studying and classifying the ventilating function of the nose. Zhur. ush., nos. i gorl. bol. 21 no.5:45-49 S-O '61. (MIRA 15:1)

1. Iz otdeleniya bolezney ukha, gorla i nosa 2-y gorodskoy bol'nitsy g. Bel'tsy.
(NOSE) (SPIROSCOPE AND SPIROSCOPY)

TSYPIN, M. Ya., kand med. nauk

Rare case of diastasis of the nasal bones. Vest. otorin. no.1: 90-92 '63. (MIRA 16:9)

1. Iz Otorinolaringologicheskogo otdeleniya Gorodskoy bol'ntisy no.2, Bel'tsy.
(NOSE— ABNORMITIES AND DEFORMITIES)

TSYPIN, M.Ya.

Closure of postoperative defects of the upper jaw. Zdravo-
okhraneniye 6 no.1:59 J-F'63. (MIRA 16:8)

1. Iz 2-y bol'nitsy g. Bel'tsy (glavnyy vrach I.N.Sarukhanova)
(JAWS--SURGERY) (SURGERY, PLASTIC)

TSYPKIN, M. YE.

FA 234T82

USSR/Mathematics - Riemannian Space, Tensors   1 Sep 52

"Correspondence Between Linear Surfaces and Curves in a Riemannian Space," A. P. Norden, M. Ye. Tsypkin, Kazan' State U imeni Lenin

"Dok Ak Nauk SSSR" Vol 86, No 1, pp 23-26

The manifold of straight lines whose Pluecker coordinates satisfy the linear eqs $v_a x^a = 0$ ($a = 1, \ldots, 6$) is called a linear complex or screw v, and its 6 numbers are called its coordinates. Gives summary of results, in the form of

234T82

9 theorems, of an investigation into linear surfaces. Submitted by Acad S. L. Sobolev 4 Jul 52.

234T82

ARSEN'YEV, Sergey Pavlovich, kand. tekhn. nauk; YEFREMOV, G.V., retsenzent; TSYPIN, M.Ye., retsenzent; MIRONOV, V.P., red.; LOBANOV, Ye.M., red. izd-va; BODROVA, V.A., tekhn. red.

[Prospective types of river transportation vessels] Perspektivnye tipy rechnykh transportnykh sudov. Moskva, Izd-vo "Rechnoi transport," 1962. 162 p. (MIRA 15:4)
(Ships) (Inland water transportation)

S/076/60/034/012/019/027
B020/B067

AUTHORS: Nikulin, V. N. and Tsypin, M. Z.

TITLE: Electrode Potentials of the Silver Monocrystal

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 12, pp. 2814-2816

TEXT: The authors attempted to study the dependence of the electrode potential of the silver monocrystal on the crystallographic orientation and the composition of the electrolyte. The breeding of silver monocrystals and the production of the electrodes have been described already earlier (Ref. 7). The static and dynamic potentials were measured by a high-impedance potentiometer of the type ППТВ(PPTV) and the ГЗС-53 (GZS-53) mirror galvanometer. A saturated calomel half-cell was used as reference electrode. The results of the potential measurements in cyanide solution (Ref. 8) and in a sodium thiosulfate solution are given in Tables 1 and 2. The static, steady potentials of silver measured in different electrolytes are given in Table 3. The potential values mentioned were referred to the potential of the ordinary hydrogen electrode. The values for the silver

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Electrode Potentials of the Silver Monocrystal S/076/60/034/012/019/027
B020/B067

potentials given in the Tables prove that the potential depends on the crystallographic orientation and the surface structure of the electrode with the surface difference during polarization and in nonequilibrium state being more pronounced. The results obtained indicate that the electrode potentials of silver are determined not only by the interaction forces in the crystal lattice but also by the interaction forces of the ion atoms with the molecules or ions of the electrolyte. There are 3 tables and 8 references: 6 Soviet, 1 US, and 1 British.

ASSOCIATION: Kazanskiy khimiko-tekhnologicheskiy institut im. S.M.Kirova (Kazan' Institute of Chemical Technology imeni S. M. Kirov)

SUBMITTED: April 8, 1959

Card 2/2

NIKULIN, V.N.; TSYPIN, M.Z. (Kazan')

Electrode potentials of a silver monocrystal. Zhur. fiz. khim. 34 no.12:2814-2816 D '60. (MIRA 14:1)

1. Kazanskiy khimiko-tekhnologicheskiy institut imeni S.M.Kirova.
(Silver crystals—Electric properties)
(Electromotive force)

NIKULIN, V.N.; TSYPIN, M.Z.

Electrolytic polishing of silver in sodium thiosulfate solutions.
Zhur.prikl.khim. 33 no.2:469-471 F '60.
(MIRA 13:5)
(Silver) (Electrolytic polishing)
(Sodium thiosulfate)

5(4)
AUTHORS: Trifonov, N. A. (Deceased), Tsypin, M. Z. SOV/76-33-6-32/44

TITLE: Physico-chemical Analysis of the Dioxane-water System From the Shape of the Electroconductivity Isothermals (Fiziko-khimicheskiy analiz sistemy dioksan-voda po forme izoterm elektroprovodnosti)

PERIODICAL: Zhurnal fizicheskoy khimii, 1959, Vol 33, Nr 6, pp 1378-1380 (USSR)

ABSTRACT: Although dioxane and dioxane-water mixtures are much in use in chemical practice, the problem of the nature of this system has not been definitely solved up to now. In the present paper, the investigation results on the electroconductivity (E) of this system are presented. The (E) was measured by means of a Wheatstone bridge at temperatures of 25, 50 and 75 $\pm 1^{\circ}$ C. The dependence of (E) on the storing time was investigated, and the measurements were carried out after 24 hours, 3, 8, 36 and 50 days. The isothermals of (E) obtained (Fig 1) may be assigned to the seventh type of isothermals, and clearly point to a formation of chemical compounds. It was already ascertained (Ref 14) that two compounds exist. In the present case, a minimum of the isothermal at 33 Mol% of dioxane confirms the formation of only one compound - the dioxane dihydrate. From an abrupt curve change at ~ 20 Mol% of dioxane, the formation

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Physico-chemical Analysis of the Dioxane-water System From the SOV/76-33-6-32/44
Shape of the Electroconductivity Isothermals

of the second compound - dioxane tetrahydrate - can be assumed. The experimental results obtained do not confirm the assumption of Ref 4 that a uniform change of (E) from water to dioxane takes place. There are 3 figures and 16 references, 9 of which are Soviet.

ASSOCIATION: Khimiko-tekhnologicheskiy institut im. S. M. Kirova, Kazan'
(Chemical-technological Institute imeni S. M. Kirov, Kazan')

SUBMITTED: December 6, 1957

Card 2/2

NIKULIN, V.N. (Kazan'); TSYPIN, M.Z. (Kazan')

Cathodic reduction of oxalic acid in relation to the structure and crystallographic characteristics of the lead electrode. Zhur. fiz. khim. 35 no.1:58-61 Ja '61. (MIRA 14:2)

1. Kazanskiy khimiko-tekhnicheskiy institut im. S.M.Kirova.
(Oxalic acid) (Lead)

18.7300

77662
SOV/80-33-2-37/52

AUTHORS: Nikulin, V. N., Tsypin, M. Z.

TITLE: Brief Communications. Electrolytic Polishing of Silver in Sodium Thiosulfate Solutions

PERIODICAL: Zhurnal prikladnoy khimii, 1960, Vol 33, Nr 2, pp 469-471 (USSR)

ABSTRACT: Electrolytic polishing of silver in a sodium thiosulfate solution gave very good results, comparable to those obtained in cyanate or thiocyanate baths. Stainless steel cathodes were used; their sizes were 4 to 5 times as large as the size of the treated objects. Optimal conditions were as follows: concentration of the electrolyte, 600 to 1300 g $Na_2S_2O_3 \cdot 10H_2O$ per liter; current density, 4 to 5 amp/dm^2; temperature, 20 to 25° C. Intermittent current was used with working periods of 5-4 seconds. To prevent the darkening of the solution by insoluble silver sulfides which make direct observation of the treated objects impossible, a separating diaphragm was used; $NaNO_3$ solution (200 g/liter) was the catholyte

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used here. Raising the current density above the optimum value causes the covering of the entire surface with a film and the cessation of the polishing; lowering the current density below the optimum value causes the dissolving of the treated surface. The process is accompanied by a periodic formation and dissolution of a film on the silver surface, similarly to electrolytic polishing using cyanate solutions. It can be assumed, therefore, that the mechanism of the smoothing of the surface is identical in both instances. There are 7 Soviet references.

SUBMITTED: April 9, 1959

5(0) PHASE I BOOK EXPLOITATION SOV/2019

Kazan. Khimiko-tekhnologicheskiy institut imeni S.M. Kirova

Trudy, vyp. 22, khimicheskiye nauki (Transactions of the Chemical and Technological Institute imeni S.M. Kirov, Kazan. Nr 22, Chemical Sciences) Kazan', 1958. 173 p. Errata slip inserted. 500 copies printed.

Editorial Board: K.N. Mochalov (Resp. Ed.) Professor, A.A. Trufanov, (Resp. Ed.) Professor, I. Ye. Moysak (Deputy Resp. Ed.) Professor, G.S. Vozdvizhenskiy, Professor, A. Ye. Arbuzov, Academician, Kh. M. Mushtari, Professor, S.M. Kochergin, Professor, A.M. Grigor'yev, Professor, N.A. Kholevo, Professor, Dzh. A. Tarzimanov (Resp. Secretary) Docent; Ed.: Yu. Karev; Tech. Ed.: I. Kh. Zaynullin.

PURPOSE: This book is intended for industrial chemists, technologists, scientists, teachers, and research students in applied chemistry.

COVERAGE: The collection contains reports by faculty members of the sponsoring institute and also commemorates the 75th year of the birth and first anniversary of the death of Professor Aleksey Mikhaylovich Vasil'yev, Doctor of Chemical Sciences and Head of the Faculty. A review of Vasil'yev's scientific activities is given along with a chronological bibliography of his published works and that of members of the institute under his leadership. Articles of the collection deal mainly with electro-chemistry and the analysis of electrochemical processes, chemical analyses, and investigations of the prospective application of physiochemical phenomena in industrial processes, e.g., cleansing with ultrasound, enhancing the properties of building materials with additives, etc. References are given at the end of each article.

TABLE OF CONTENTS:

Transactions of the Chemical (Cont.) SOV/2019

Card 4/6

"Physicochemical Properties of the System Dioxane-water." Cand Chem Sci, Kazan' Chemicotechnological Inst, Kazan', 1954. (RZhKhim, No 1, Jan 55)

Survey of Scientific and Technical Dissertations Defended at USSR Higher Educational Institutions (13)
SO: Sum. No. 598, 29 Jul 55

TSYPIN, M.Z.; GOLIKOV, G.A.; KARASEVA, Ye.D.

Photogalvanic effect, work function of an electron and catalytic activity of an oxidized silver electrode. Zhur. fiz. khim. 39 no.4: 890-892 Ap '65. (MIRA 19:1)

1. Kazanskiy khimiko-tekhnologicheskiy institut. Submitted Oct.25, 1963.

TSYPIN, N.

Strengthen control over the disbursement of wage funds on state farms. Fin.SSSR 16 no.10:73-76 O '55. (MLRA 9:2)
(State farms) (Wages)

ACC NR: AP7000800 (A,N) SOURCE CODE: UR/0089/66/021/005/0395/0397

AUTHOR: Degtyarev, S. F.; Kikhtevich, V. I.; Tikhonov, V. K.; Tsypin, S. G.

ORG: none

TITLE: Dependence of the accumulation factor of fast neutrons on the relative arrangement of the shield and detector

SOURCE: Atomnaya energiya, v. 21, no. 5, 1966, 395-397

TOPIC TAGS: fast neutron, neutron radiation, radiation intensity, lithium compound, neutron shielding, neutron distribution, neutron detector

ABSTRACT: The authors present results of an experimental and theoretical investigation of the dependence of the flux of fast neutrons with energy $E \geq 0.7$ Mev on the distance R for a constant distance between the source and the shield. The shielding barriers used were plates of lithium hydride 45 and 60 cm thick and of density 0.5 g/cm^3. The transverse dimensions of the plates were chosen such that the detector placed inside the shield or on its surface was under conditions of so-called infinite geometry. The neutron flux was registered by scintillation counters of ZnS(Ag) powder pressed in Plexiglas. The quantitities measured directly were the fast-neutron flux on the surface of the shield and the flux at a distance R from the shield. The background was determined by suppressing the primary effect with the aid of an additional shield. In the reduction of the data use was made of earlier investigations by the authors, reported in the same source (p. 392, Acc. Nr. AP7000798) of the

Card 1/2 UDC: 539.125.52: 539.121.72

ACC NR: AP7000800

angular distribution of neutrons. The experimental values obtained for the build up factor as a function of the distance from the shield to the detector are found to be in agreement with formulas derived on the basis of numerous published theoretical papers. The results show that, with increasing distance from the shield, the fraction of the scattered radiation in the total neutron flux decreases, and the fraction of the unscattered radiation increases. Orig. art. has: 4 figures and 7 formulas.

SUB CODE: 20,18/ SUBM DATE: 05Jul66/ ORIG REF: 005/ OTH REF: 001

Card 2/2

TSYPIN, S. G.

USSR/Nuclear Physics - Penetration of Charged and Neutral Particles Through Matter, C-6

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34108

Author: Tsypin, S. G., Kukhtevich, V. I., Kazanskiy, Yu. A.

Institution: None

Title: Penetration of Gamma Rays Through Water, Iron, Lead, and a Combination of Iron and Lead

Original Periodical: Atom. Energiya, 1956, No 2, 71-74

Abstract: The attenuation of the dosage of gamma rays in Fe, water, and Pb is measured for an "infinite" geometry. In the "barrier" geometry, the dosage attenuation of gamma rays was measured for mixtures of iron and lead. The experimental data obtained are compared with the results of calculations based on the Fano theory.

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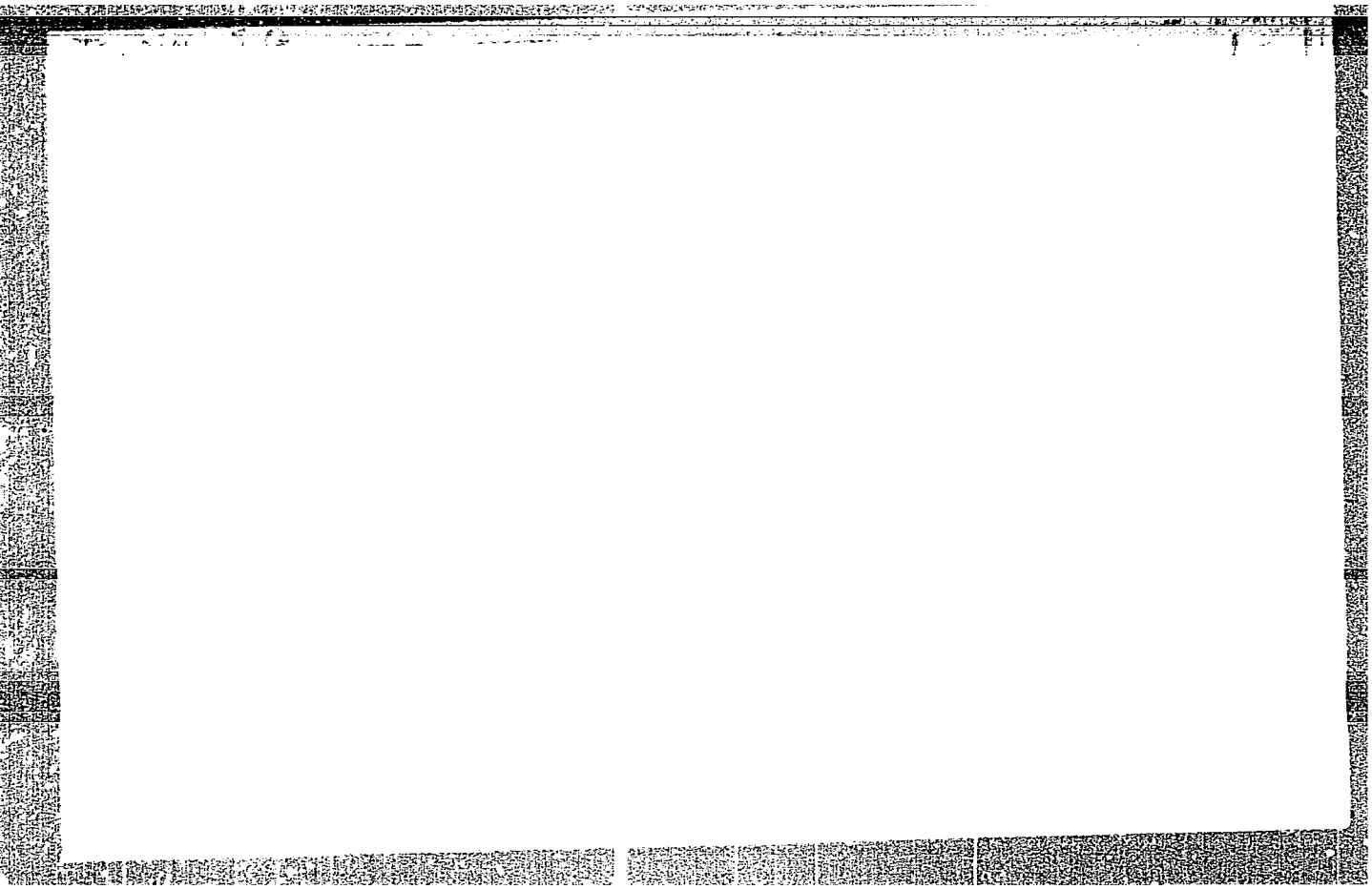

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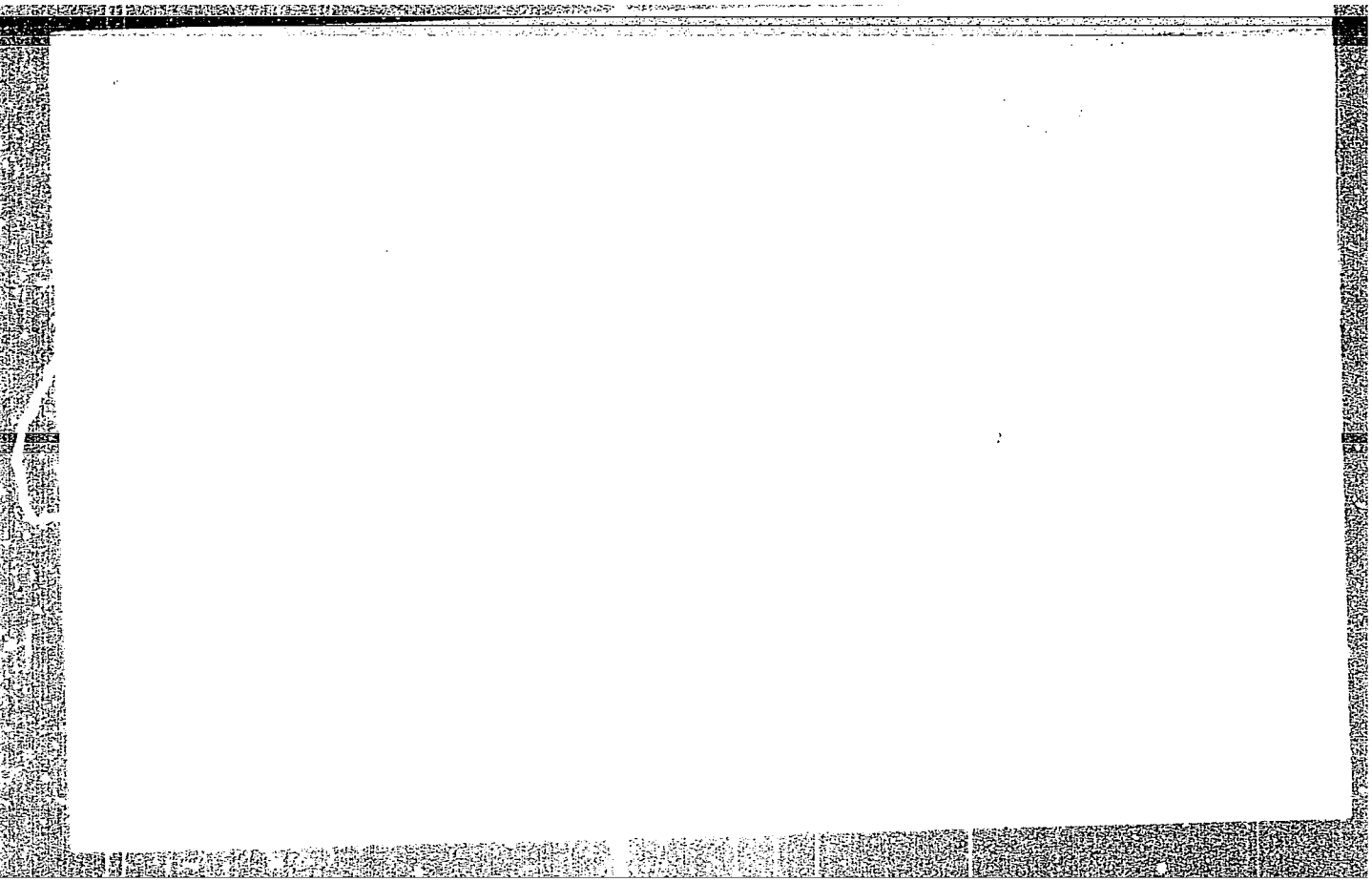

TSYPIN, S.G.

AUTHORS: Kukhtevich, V.I., Tsypin, S.G. 89-7-15/32

TITLE: Weakening of γ-Rays Formed During the Capture of Neutrons in Chalybeate Mixtures (Oslableniye γ-luchey, obrazuyushchikhsya pri zakhvate neytronov v zhelezovodnykh smesyakh)

PERIODICAL: Atomnaya Energiya, 1957, Vol. 3, Nr 7, p 56 (USSR)

ABSTRACT: The present paper investigates the influence exercised by the concentration of iron in water on the relaxation-length of the γ-rays which are produced in the capture of neutrons. The nuclear reactions $D(d,n)He^3$ (energy of the neutrons $E_0 = 4.0 \pm 0.2$ MeV) and $T(d,n)He^4$ (energy of the neutrons $E_0 = 14.9 \pm 0.4$ MeV) were used as neutron sources. These energy values correspond to the emission of neutrons under the angle 0° contrary to the direction of the deuteron beam. The experimental device consisted of a vessel with water in which iron foils 60x60 were arranged. Interspaces filled with water remained between these foils. The concentration of iron in water was modified by the modification of the thickness of these cores while the distance between them was not changed. An ionization chamber with a sensitive volume of 1.5 cm^3 and a γ-counter with a volume of about 4 cm^3 were used as detectors of the γ-rays.

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The Weakening of γ-Rays Produced on Capture of Neutrons in Iron-Water Mixtures 89-7-15/32

The casing of the ionization chamber was made of graphite, the insulator of teflon. The neutron source and the detector of the γ-rays were fastened in the water vessel between the cores, the neutron source being firmly arranged and the detector being set up in different distances from the source. The contribution of the neutrons to the deflections of the γ-detectors was estimated by calculation and experiment. A diagram illustrates the dependence of the effective relaxation-length of the γ-rays produced on capture of the neutrons on the volume concentration of iron in the iron-water mixture for the two initial energies of the neutrons E_0 = 4 MeV and E_0 = 14.9 MeV. The effective relaxation-lengths were calculated from the curves for the weakening of the γ-rays (which were produced by the capture of neutrons in an iron-water mixture with a thickness of 25-80 cm). Both curves have a distinctly marked minimum of the effective relaxation length at a concentration of the iron of 60% in the iron-water mixture. An empirical formula for the calculation of the

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During the

Weakening of -Rays Formed ∧ Capture of Neutrons 89-7-15/32
in Chalybeate Mixtures

effective relaxation lengths is given. There are 1 figure and 2 Slavic references.

SUBMITTED: March 7, 1957

AVAILABLE: Library of Congress

Card 3/3 1. Gamma rays - Attenuation - Effects of iron in water
2. Neutron capture 3. Gamma counters - Applications

TSYPIN, S. G.

HIGH-ENERGY NUCLEAR PHYSICS: PARTICLE BOMBARDMENT OF NUCLEII

"The Passage of Scattered -Rays Through Water," by V. I. Kukhtevich, A. A. Kazanskiy, Sh. S. Nikolayshvili, anD S. G. Tsypin, Atomnaya Energiya, No 2, February 1958, pp 138-143.

Measurements were made of the attenuation of the dose of scattered quanta from Au^{198}. Co^{60}. and Na^{24} sources, as functions of the distance between the source and detector at various angles of collimation, which excluded the possibility of a primary -ray entering into the detector Measurements were carried out at distances from 3 to 4 to 8 to 10 mean free paths of the -quanta. The collimation angles varied from 30 to 80 degrees. The experimental data obtained are compared with the results of theroetical calculations, based on an assumption that makes it possible to reduce the problem to the calculation of the triple integral, instead of a direct solution of the kinetic equation. Statisfactory agreement between the experimental and theroetical results is obtained.

CYPIN, S.G. [Tsypin, S.G.]; KUCHTEVIC, V.I. [Kukhtevich, V.I.]; KAZANSKIJ, J.A. [Kazanskiy, Yu.A.]; KAPLAN, J. [translator]

Penetration of gamma rays through water, iron, lead and combined layers of iron and lead. Jaderna energie 4 no.7:191-193 Jl '58.

AUTHORS: Kukhtevich, V. I., Tsypin, S. G. SOV/89-5-4-1/24

TITLE: Physics- and Engineering Problems of the Construction of ... tective Shields of Small Dimensions (Fizicheskiye i inzhenernyye problemy konstruirovaniya malogabaritnykh zashchit)

PERIODICAL: Atomnaya energiya, 1958, Vol 5, Nr 4, pp 393-402 (USSR)

ABSTRACT: The following physical problems which have to be taken into account when designing protective shields for small devices are dealt with in an article compiled from numerous foreign and Soviet data:
Type of radiation from the reactor.
Interaction of γ-rays with materials of various thicknesses and composition.
Interaction of neutrons with materials of various thicknesses and composition.
Production and attenuation of capture-γ-rays.
Shadow shields.
With respect to engineering the following problems are raised and described:
Composition of the protective shield.

Card 1/2

Physics- and Engineering Problems of the Construction of Protective Shields of Small Dimensions

Selection of material.
Optimum arrangement of various good protective layers.
Although it is possible numerically to calculate a series of factors which influence the protective properties, an experimental examination of the protective properties of the completed shield is nevertheless advisable. There are 3 figures and 52 references, 23 of which are Soviet.

SUBMITTED: May 10, 1958

21(7) SOV/89-5-5-11/27

AUTHORS: Kukhtevich, V. I., Sinitsyn, B. I., Tsypin, S. G.

TITLE: The Removal Cross Section of Fast Neutrons With an Energy of 2,9 MeV (Secheniye vyvedeniya bystrykh neytronov s energiyey 2,9 Mev)

PERIODICAL: Atomnaya energiya, 1958, Vol 5, Nr 5, pp 565-566 (USSR)

ABSTRACT: Measurement was carried out in a rectangular container of water, in which the material to be investigated (80.80.10 to 20 cm) was placed against one of the walls. The neutron source was located on the outside of this wall. The $D(d,n)He^3$ reaction was used. Neutron energy: 2,9 ± 0,1 MeV. A BF_3-counter could be freely moved along the axis of the container. The following removal cross sections were measured:

Element	σ_r in b	distance absorber - detector in cm
B	1,38 ± 0,13	20
C	1,58 ± 0,02	42

Card 1/3

The Removal Cross Section of Fast Neutrons With an Energy of 2,9 MeV

Element	σ_r in b	distance absorber - detector in cm
Al	1,68 ± 0,07	47
Fe	1,96 ± 0,04	45
Ni	1,90 ± 0,03	57
Cu	2,34 ± 0,13	66
Nb	2,93 ± 0,52	20
Pb	3,72 ± 0,13	65

The grave measuring error committed with respect to B may be explained by the fact that B_4C was used as an absorber. In the case of niobium the inaccuracy is caused by the fact that niobium powder was used which contained 15 per cent of weight of water.

By plotting the dependence of the removal cross section referred to the mass unit upon the weight of the atoms of the absorber, a curve is obtained which can be represented by means of the following empirical formula:

The Removal Cross Section of Fast Neutrons With an Energy of 2,9 MeV

$\sum r/\varrho = 0{,}385\ A^{-0{,}688}$, for 2,9 MeV neutrons.

The results obtained were discussed with I. I. Bondarenko, Doctor of Physico-Mathematical Sciences. A. N. Serbinov, Candidate of Technical Sciences , and I. A. Vorontsov assisted in carrying out experiments. There are 1 figure, 2 tables, and 6 references, 1 of which is Soviet.

SUBMITTED: June 25, 1958

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21(7)

AUTHORS: Kukhtevich, V. I., Tsypin, S. G., Shemetenko, B. P.

SOV/89-5-6-5/25

TITLE: The Angular Distribution of the Dose of the Scattered γ-Radiation of a Co^{60}-Source in Water (Uglovoye raspredeleniye dozy rasseyannogo γ-izlucheniya ot istochnika Co^{60} v vode)

PERIODICAL: Atomnaya energiya, 1958, Vol 5, Nr 6, pp 638 - 641 (USSR)

ABSTRACT: In a vessel filled with water (2.2,2.1,6 m^3) a Co^{60}-source (spherical-shaped, diameter: 0,5 cm, activity: 0,197 ±0,020 and 1,370 ±0,014 C respectively) and a γ-detector were arranged at a maximum distance from each other. The γ-detector was a scintillation-dosimeter (anthracene crystal: height 0,5 cm, diameter 1,2 cm (for case a) and 0,7 cm (for case b). Between the crystal and the photocathode of the multiplier there was a light pipe from organic glass. By means of the dosimeter it was possible to measure doses of from $0,4.10^{-2}$ to 40r/h (diameter of crystal 1,2 cm) and of $2,33.10^{-2}$ to 233 r/h (diameter of crystal 0,7 cm).

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The Angular Distribution of the Dose of the Scattered γ-Radiation of a Co^{60}-Source in Water

In the case of a, an uranium truncated cone of 4 cm height was placed between the source and the detector in front of the source. The aperture angles are 3; 5; 7; 10; 18,5; 28,5; 45; 65; and 80°. In the case b, the uranium truncated cone is in front of the detector. The aperture angles were 9,5; 12; 19,5; 27; 37; 55; and 71°.
The dependence of dosage on the various aperture angles (the distances between source and detector were varied up to 80 cm within the range of 14 cm) is graphically represented. Furthermore, the ratio (P in %) of dosage efficiency with and without uranium truncated core was measured in dependence on the aperture angle.
The results obtained show that dosage efficiency and P decrease in a higher degree for case a, in dependence upon the aperture angle.
A comparison with data supplied by other papers shows that in all papers the same regularity as regards quality is found.
The results obtained were discussed with I. I. Bondarenko, Doctor of Physico-Mathematical Sciences, and with Sh. S. Nikolayshvili. V. P. Saltykova assisted in carrying out

The Angular Distribution of the Dose of the Scattered γ-Radiation of a Co^{60}-Source in Water

SOV/89-5-6- 5/25

measurements. There are 5 figures and 7 references, 1 of which is Soviet.

SUBMITTED: June 25, 1958

Card 3/3

21(7) SOV/89-6-6-11/27

AUTHORS: Belov, S. P., Dulin, V. A., Kazanskiy, Yu. A., Zukhtevich, V. I., Tsypin, S. G.

TITLE: Space and Energy Distribution of the Neutrons in Boron Carbide (Prostranstvennoye i energeticheskoye raspredeleniye neytronov v karbide bora)

PERIODICAL: Atomnaya energiya, 1959, Vol 6, Nr 6, pp 663 - 665 (USSR)

ABSTRACT: The authors report on investigations of space and energy distributions of 3 and 15 Mev neutrons in boron carbide. The 3 Mev neutrons were the product of the reaction $H^2(H^2,n)He^3$, the 15 Mev neutrons from $H^2(H^3,n)He^4$. The test arrangement (infinite geometry) is briefly described. Boron carbide $\gamma = 1.18 \pm 0.05$ g/cm^3; neutron detectors: 1) proportional counter with BF_3 enriched to 88% with B^{10}; 2) fission chamber with natural uranium, U^{235} (enriched to 75%), and Th^{232}; 3) threshold indicators: $P^{31}(n,p)Si^{31}$, $Al^{27}(n,p)Mg^{27}$, $Fe^{56}(n,p)Mn^{56}$, $Sb^{121}(n,2n)Sb^{120}$, $Cu^{63}(n,2n)Cu^{62}$, $In^{115}(n,\gamma)In^{116m}$. Figure 1 shows the space neutron distribution (3 and 15 Mev) in the passage through

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boron carbide. Detectors for the 3 Mev neutrons: 1) and 2), for the 15 Mev neutrons, 2) and 3). It was found among others that an increase of the threshold energy of the detector increases the inclination of the attenuation curves of the neutrons. In measuring the 15 Mev neutron attenuation by means of the indicator $Cu^{63}(n,2n)Cu^{62}$ (E_{thresh} = 10.9 Mev) the relaxation path for the distance source - detector $R > 16$ cm does not change and is close to the transport path $\lambda_{tr} = 18 \pm 2$ cm. A comparison of the data contained in the present paper with those from reference 1 (Geneva Paper Nr 2147, 1958) is briefly discussed. The following relative capture figures are determined:

indicator:	Cu^{63}	Sb^{121}	Fe^{56}	Al^{27}	P^{31}	In^{115}
measurement by counter	6.5±1	8±2	1	0.73±0.15	1.04±0.15	-
by spectrometer	-	-	1	0.65±0.15	-	6±2

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Figure 2 shows the energy distribution of the neutron flux in boron carbide for different intervals (energy interval 1.5 - 15 Mev, results standardized in the interval 13.5-15 Mev). Moreover, the ratio between $\sigma_{U\ 235}(E_{eff})$ and $\sigma_{B\ 10}(E_{eff})$ of the reaction (n,α) with B^{10} in boron carbide was determined. In the case of 3 Mev neutrons 0.97 ± 0.03 was obtained at E_{eff} = 120±10 kev. In conclusion, the authors thank I. I. Bondarenko for advice and discussions, N. D. Proskurnina, V. F. Bashmakov, A. N. Nikolayev, and V. I. Popov for assistance in the experiments as well as A. N. Serbinov and I. A. Vorontsov for work at the neutron generator. There are 2 figures, 1 table, and 4 references, 2 of which are Soviet.

SUBMITTED: January 6, 1959

Tsypin, S.G.

84233

26.2241
21.1900

S/089/60/009/004/013/020
B006/B070

AUTHORS: Dulin, V. A., Kazanskiy, Yu. A., Mashkovich, V. P., Panov, Ye. A., Tsypin, S. G.

TITLE: Investigation of the Attenuation Functions for Water Exposed to Isotropic and Highly Collimated Sources of Fission Neutrons 19

PERIODICAL: Atomnaya energiya, 1960, Vol. 9, No. 4, pp. 315 - 317

TEXT: In this "Letter to the Editor", the authors report on an experimental investigation of the space distribution of fission neutrons in water, the source of neutrons being a БР-5 (BR-5) reactor. The neutrons came out of a hole in a concrete shield (diameter 250 mm) and fell on a tank (137·139·217 cm) filled with doubly distilled water. The neutron beam had a total angular divergence of ~5°. The neutrons were detected by proportional boron counters. Measurements could be made at each point of the tank, and the position of the point could be determined with an accuracy of 1 mm. Fig. 1 shows the geometry. Figs. 2 and 3 show the measured neutron distributions for different values of r (distance from

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the source) and different values of h (distance from the beam). Fig. 4 shows the attenuation function of neutrons of an isotropic point source multiplied by r^2 (curve a), and the attenuation function of a highly collimated plane source (b). The maximum error of the curve a occurs for small r (r = 40 cm, ~20%), and the minimum error (~5%) occurs for large r. The error of the curve b is between ~5% for r = 40 cm and ~20% for r = 140 cm. The two curves diverge from each other by about 20%, but this is within the limits of the error of measurement. Therefore, for thicknesses of water shield larger than 40 cm, the two curves may be considered to be coincident. Fig. 5 shows, for comparison, the experimentally obtained (Ref. 2) attenuation functions for neutrons of an isotropic disk source (diameter 71.2 cm). The attenuation functions according to which the curves are drawn read:

$$G_{point}(r) = C_1 \int_0^{\pi/2} N(r,\theta)\sin\theta d\theta; \quad G_{plane}(r) = C_2 \int_0^{\infty} N(r,h)h\,dh; \text{ and}$$

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$$D_{disk}(r,a) = 2\pi \int_r^{\sqrt{r^2+a^2}} G_{point}(R)R\,dR.$$

a is the radius of the disk; $N(r,\theta)$ and $N(r,h)$ are the distribution functions shown in Figs. 2 and 3; and the C_i are constants. The authors thank O. I. Leypunskiy and V. V. Orlov for discussions and comments. There are 5 figures and 4 references: 2 Soviet and 2 US.

SUBMITTED: April 27, 1960

Card 3/3

84234

S/089/60/009/004/014/020
B006/B070

21.1700
26.2244

AUTHORS: Dulin, V. A., Mashkovich, V. P., Panov, Ye. A., Tsypin, S.G.

TITLE: Energy Distribution of Fast Fission Neutrons in Water

PERIODICAL: Atomnaya energiya, 1960, Vol. 9, No. 4, pp. 318 - 319

TEXT: The authors report on an experimental investigation of the energy distribution in water of fission neutrons from BP-5 (BR-5) reactor. The experimental arrangement is described in Ref. 5. The fast neutrons were detected by threshold indicators which had the form of disks of a diameter of 35 mm and different thicknesses. Data referring to these indicators are given in a table. The disks were oriented at different angles θ with the direction of the incident neutron beam, and placed at different distances h from the beam. Fig. 1 shows the activity of the indicators as a function of θ for $r = 30$ cm (normalized at $\theta = 9^0$). Fig. 2 shows the activity of phosphorus indicators as a function of h for $r = 30$ cm, and $r = 60$ cm (normalized at $h = 0$). Fig. 3 shows the energy distribution of neutrons in water at distances of 30 and 60 cm, calculated from the geometry of the experiment for a point source. The neutron

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spectrum is obtained from a solution of the system of equations $N_i(r)$ $= c\varepsilon_i\left[1-\exp(-\lambda_i T)\right]\cdot\exp(-\lambda_i t)\int_{E_{t_i}}^{\infty}\Phi(r,E)\sigma_i(E)dE$

$= c\varepsilon_i\left[1-\exp(-\lambda_i T)\right]\exp(-\lambda_i t)\sum_{j=1}^{n}\Phi_j(r,\bar{E})\sigma_{ij}(E)\cdot\Delta E_j$ by the method of successive approximations. Here, $N_i(r)$ denotes the activity of the i-th threshold indicator at a distance r from the source after irradiating the indicator for a time T and then waiting for a time t; ε_i is the efficiency of the recording of the activity of the indicator including the correction for absorption and scattering in the sample, air, and counter window; $\sigma_i(E)$ is the reaction cross section at energy E; $\Phi(r,E)$ is the differential neutron flux of energy E at a distance r from the source; c is a constant; i is the index of the indicator (i = 1,2,..n); and j is the index of the

energy range. $N_i(r)$ is calculated from the formula $N_i(r)=c_1\int_0^{\pi/2} N_i(r,\theta)\sin\theta d\theta$, where $N_i(r,\theta)$ is the activity of the i-th threshold indicator at a distance r and an angle θ; c_1 is a constant. The relative ε_i values were determined experimentally for each indicator. Fig. 3 gives a comparison of the data obtained with the calculated neutron spectrum (Ref. 1) (normalized at r = 30 cm). The divergences between the two lie between 30 and 50%, which is practically within the limits of error (~30%). The authors thank O. I. Leypunskiy and V. V. Orlov for discussions and comments. There are 3 figures and 6 references: 3 Soviet and 3 US.

SUBMITTED: April 27, 1960

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ORLOV, V.V., kand. fiz.-mat. nauk, red.; TSYPIN, S.G., kand. fiz.-mat. nauk, red.; KAZANSKIY, Yu.A.[translator]; KUKHTEVICH, V.I. [translator]; MATUSEVICH, Ye.S. [translator]; NIKOLAYSHVILI, Sh.S. [translator]; SINITSYN, B.I. [translator]; YUS, S.V. [translator]; VISKOVA, M.V., red.; RYBKINA, V.P., tekhn. red.

[Protection of transportation units having nuclear engines; translated articles] Zashchita transportnykh ustanovok s iadernym dvigatelem; sbornik perevodov. Moskva, Izd-vo inostr. lit-ry, 1961. 619 p. (MIRA 14:12)

(Radiation protection) (Nuclear reactors—Safety measures)

S/089/61/011/003/008/013
B102/B138

26.2241

AUTHORS: Mashkovich, V. P., Tsypin, S. G.

TITLE: Spatial fast-fission neutron distribution in iron

PERIODICAL: Atomnaya energiya, v. 11, no. 3, 1961, 251-255

TEXT: The spatial neutron distribution has hitherto been insufficiently determined in iron, one of the cheapest and commonest shielding materials. The authors, therefore, made new measurements using the BR-5 (BR-5) reactor. Sets were composed of six iron plates (each 19.5 mm thick), and seven sets were joined to form a prism (1320·1360·1880 mm). Every set had vertical holes (90 mm in diameter, 830 mm deep) for introducing detection probes. While not being used for measurements, the holes were occupied by iron rods. The immersion depth of probes was controlled with an accuracy of 1 mm. Iron Cr.-0 (St.-0) was used (0.6 % impurities: C, Mn, S, P). The threshold indicators: $S^{32}(n,p)P^{32}$, 3 Mev and $Al^{27}(n,\alpha)Na^{24}$, 7 Mev, were used as neutron detectors. The former were 6 mm long, and the latter 20 mm. Both were disk-shaped (35 mm in diameter). The iron prism was irradiated perpendicular to the plate plane by neutrons from a

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Spatial fast-fission neutron...

250 mm wide reactor channel. The neutron energies ranged between 1 and 8 Mev. The N(E) spectrum displayed an almost linear drop with a rise of E. The activity of the sulfur probes was determined from the decay curves, and that of the aluminum probes from the photoelectron peaks due to the 2.76-Mev gamma radiation from Na^{24}. Correction was made for the activity of the Na^{23} impurity. With this system of plates and probes, the neutron flux attenuation could be determined both in the direction of irradiation and perpendicular to it. Activity was measured on the indicators after 15-20 hr with an end-window counter. Measurements were also made with a fission chamber (Th^{232}, 2 Mev) and an $Mg^{24}(n,p)Na^{24}$ threshold indicator (5 Mev). The following relaxation lengths (in cm) were measured:

Indicator	Thickness range of Fe, cm	Relaxation length in the direction of central beam	Relaxation length for plane unidirectional source
$Th^{232}(n,f)$	50	6.5	7.5
$S^{32}(n,p)P^{32}$	65	5.6	6.5
$Mg^{24}(n,p)Na^{24}$	40	5.6	6.3
$Al^{27}(n,\alpha)Na^{24}$	85	5.8	6.3

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S/089/61/011/003/008/013
B102/B138

These dataare in good agreement with experimental measurements made by other authors, and differ by only about 10 % from the theoretical calculations in Ref. 10. The asymptotic interaction cross sections were calculated in transport-theoretical approximation and were found to range between 1.9 and 2.1 barns. O. I. Leypunskiy, I. I. Bondarenko, V. V. Orlov are thanked for discussions, Yu. K. Yermakov, degree student of MIFI, A. V. Larichev, and A. N. Nikolayev for assistance. There are 6 figures, 2 tables, and 11 references; 7 Soviet and 4 non-Soviet. The three references to English-language publications read as follows: Ref. 3: D. Wood, Nucl. Sci. and Engng., 5, 45 (1959); Ref. 4: E. Blizard. Annual Rev. Nucl. Sci. 5, 91, (1955); Ref. 10: H. Goldstein. The attenuation of Gamma Rays and Neutrons in Reactor Shields, US AEC, Washington, 1957.

SUBMITTED: January 30, 1961

Card 3/3

S/069/62/012/004/004/014
B102/B104

21.5250

AUTHOR: Tsypin, S. G.

TITLE: Use of collimated neutron sources in shielding studies (for a G-2 (B-2) unit in a GP-5 (BR-5) reactor)

PERIODICAL: Atomnaya energiya, v. 12, no. 4, 1962, 300-305

TEXT: The passage of neutrons through various shielding materials is studied by a B-2 unit mounted to a fast BR-5 reactor. For shielding studies a well collimated high-energy fission neutron source (at least E > 2-3 Mev) is needed; the neutron beam passing through the shield channel and entering the B-2 unit (Fig. 2) is collimated with an accuracy of about $\pm 2.5^{\circ}$. The channel exit is covered with two slide gates: 150 cm water and 50 cm pig iron. The steel tank is designed for investigating shields of up to 50 tons. The specific weight of the shielding concrete is 4.3-4.5 g/cm^3. The fast neutron flux from the reactor (5 Mw) reached 10^{10} n/cm^2·sec. The attenuation function for a collimated disc source, $G_{c.d.}(R,h)$ was determined from the attenuation function of an infinitely

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Use of collimated neutron ...

plane source $G_{\infty\,pl.}(R) = c \int_0^{2\pi} d\varphi \int_0^{\infty} G_{c.p.}(R,h)hdh \simeq G'_{\infty\,pl.}(R)$

$= c \int_0^{2\pi} d\varphi \int_0^{\infty} G_{c.d.}(R,h)hdh$, where $G_{c.p.}$ refers to a collimated point source. $G_{\infty\,pl.}$ and $G'_{\infty\,pl.}$ differ only by a constant factor. $G_{c.d.}(R,h)$ was measured for several R values as a function of h in iron by means of fast-neutron threshold indicators $[Al^{27}(n,\alpha)Na^{24}]$. The curves obtained do not change within the limits of the beam radius, outside the radius they decrease exponentially. With increasing R (shield diameter) the slope of the curves decreases. The radiation attenuation curve also depends on the angular distribution. The functions $G_{i.p.}(R)R^2$ (for an isotropic point source) and $G_{\infty\,pl.}(R)$ do not only coincide for gamma radiation but also for neutrons. For thermal and fast neutrons, these curves were measured in water with BF_3 counters and $P^{31}(n,p)Si^{31}$ threshold indicators. Thus, from a measurement of the attenuation function for a collimated disc source in

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the B-2 unit, information is obtained on the spatial energy distribution and the angular distribution of neutrons in the shielding materials investigated. A. I. Leypunskiy, I. I. Bondarenko, V. V. Orlov, V. I. Kukhtevich, Yu. A. Kazanskiy, B. I. Sinitsyn, Ye. S. Matusevich, B. P. Shemetenko, Sh. S. Nikolayshvili, V. P. Mashkovich, and A. A. Abagyan are thanked for discussions, D. S. Pinkhasik and N. N. Aristarkhov for help. There are 5 figures, 1 table, and 18 references: 17 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: W. Stinson. Nucleonics, 12, no. 9, 50, 1954.

SUBMITTED: April 17, 1961

Legend to Fig. 2: (1) Channel, (2) shield of BR-5 reactor, (3) concrete shield, (4) shield studied. Dimensions are given in cm.

S/089/62/012/004/005/014
B102/B104

AUTHORS: 26 2240 Sinitsyn, B. I., Tsypin, S. G.

TITLE: Use of empirical constants in shield calculations

PERIODICAL: Atomnaya energiya, v. 12, no. 4, 1962, 306-314

TEXT: The results of papers on the determination and use of removal cross sections are generalized and it is tried to extend the applicability of empirical constants in the design of neutron shields. The problems are discussed for heterogeneous and homogeneous reactors, for monochromatic and fission neutron sources. The discussions lead to the following results: (1) If the spectrum of the neutrons which leave the reactor is not highly distorted in the range of 2-3 Mev, the removal cross sections given by Chapman and Storrs can be used for all hydrogen-containing media. They cannot be used for light elements as Be, B, or C since their removal cross sections increase in this energy range, a fact which has to be taken into account. (2) The removal cross sections measured in heterogeneous media can also be used for homogeneous media. The error will not exceed 5-10% for all elements. (3) The removal cross sections can be used at any

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Use of empirical constants ...

distances from the source when calculating homogeneous media. The absolute deviation from the results of exact calculations does not exceed 25-30% at distances from the source of 2-3 relaxation lengths. (4) If the removal cross sections are used for dose calculations, the dose weakening for hydrogen has to be taken into account. (5) For reactors with an effective energy threshold of 3 Mev, the cross sections obtained from the reciprocal relaxation lengths coincide with the removal cross sections given by Chapman-Storrs for hydrogen-free media. (6) The minimum distance from the source decreases with increasing energy threshold of the detector. (7) The Chapman-Storrs removal cross sections can be used for the upper groups in multigroup calculations if the effective energy threshold is 3 Mev; the asymptotic cross sections for 1.4 Mev - ∞ or the quantities $\sigma_{1/\lambda}$ corresponding to the 3-Mev threshold can be used. (8) The asymptotic cross sections for the groups 1.4 Mev - ∞ are similar to the Chapman-Storrs cross sections. (9) For a more detailed description of the spatial energy distributions of fast neutrons (E > 1 Mev) a large system of empirical constants for the groups between 1 and 18 Mev is available. A. I. Leypunskiy, I. I. Bondarenko, V. I. Kukhtevich, Yu. A. Kazanskiy, A. A. Abagyan, D. V. Pankratov, and A. P. Suvorov are thanked for advice and

Card 2/3